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ABSTRACT

The relationship between the level of researchers' dependency on funding sources and their considerations for choosing to turn to certain funding sources is examined. Monetary and non-monetary aspects of these considerations are explored. University researchers and federal government agencies have a long history of collaboration for purposes of research; now the collaboration between university researchers and industrial corporations has added another dimension to the relationship between researchers and funding agencies. It is postulated that university researchers take into consideration a number of factors that might affect their decision with regard to their funding sources, and the factors affecting the researchers' preferences are examined. Three hypotheses are: the level of dependency on external sources is related to monetary considerations which affect the decision to collaborate with specific organizations; the same levels are related to non-monetary considerations affecting the decision to collaborate with certain organizations; and researchers in public universities tend to indicate non-monetary considerations more frequently as affecting their preference than do researchers in private universities. Results indicate researchers applying to different funding sources are not attracted by the wide range of advantages this relationship offers. The three hypotheses were all partially supported by the study. Both researchers who are highly dependent on external sources and those who are not do not tend to consider non-monetary factors. Tables are included. Contains 23 references. (SM)

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The Funding Preferences of University Researchers

Ronit Bogler

Stanford University

Paper presented at the annual meeting
of the American Educational Research Association

San Francisco, CA
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Introduction

University researchers and federal government agencies have a long history of collaboration for purposes of research, each side recognizing its role in this partnership. University researchers tend to apply for support from the federal government because it is seen as the major organization, capable of financing extensive basic and applied research. In return, the federal government seeks to accumulate knowledge to benefit society as a whole.

The collaboration between university researchers and industrial corporations has added another dimension to the relationship between researchers and funding agencies. Scholars who have studied the subject of university-industry partnership have identified a number of advantages that characterize these relationships.[1] Many of the listed advantages refer to non-monetary factors which have not been proposed for university-federal government relationships. Thus, collaboration of university researchers with different funding sources contributes to the fulfillment of both monetary and non-monetary needs of the researchers.

To what extent does this reality affect the decisions of university researchers regarding the preferred sponsoring organization? Do these researchers take into considerations non-monetary factors when applying to external funding sources, or are they driven by monetary considerations only?

The purpose of this study is to examine the relationship between the level of researchers' dependecy on funding sources, and their considerations for choosing to turn to certain funding sources. In particular, monetary and non-monetary aspects of these considerations will be explored. I assume that indication of non-monetary factors as affecting the preference can take

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place only after basic monetary needs to conduct research have been fulfilled. That is, if researchers do not maintain some level of monetary support that allows them to carry out their scientific research, one cannot expect them to appreciate the value of non-monetary components that are embodied in the research enterprise. Therefore, I relate the indication of monetary and non-monetary factors that affect their preferences to the researchers' level of dependency on external sources.[2] In this study, I will not refer to the relationship between the factors affecting the preference and the preference itself. (Preference refers here to what the researchers indicate as their preferred type of organization to collaborate with.) I will investigate this relationship in another study.

This study has important implications. Policy-makers at institutions of higher education should know more about the factors affecting researchers' preferences. Administrators in these institutions often play an important role as active negotiators and mediators between the university and the external funding organizations. If the results of the study indicate that researchers do not consider non-monetary resources important factors in their decisions, then this finding should affect the ways in which policy-makers encourage collaboration between researchers and funding organizations. It might be that administrators will have to limit their efforts in encouraging professors to collaborate with organizations that can provide mainly non-monetary resources. The findings of the study should also assist policy-makers of the external funding organizations interested in collaborating with university researchers. On the theoretical level, this study will contribute to the body of knowledge about dependency relations between individual actors and organizations.

University Relations With External Sources

In the past decade, many American universities and the researchers within these institutions have been pressured to look for alternative sources of finance as a result of federal and state budget cuts. One such alternatives is to look for support from high technology industries, interested in establishing direct ties with universities. For university researchers, the main motives to interact with industries are: a) to acquire funding for basic and applied research and for graduate training, and, b) to support the building and maintenance of research facilities. These two motives seem to denote the monetary factors that affect the decision of researchers to collaborate with external funding sources.

However, there are additional reasons that make universities look for support from industry. Among these are the following: access to areas of science and technology in which the industry has developed its expertise; information exchange with colleagues; exposure of students to practical research problems; interaction with industry when explicitly required by government stipulation of cooperation with industry; and employment opportunities for the graduates. This type of reasons seems to represent the non-monetary factors behind the researchers motivation to collaborate with external funding sources.

The interests of industries in establishing research relations with universities include: access to new technology and information; access to human resources (students and professors); attachment to universities to enhance the corporation's image; support of technical excellence; potential for solving specific scientific problems relevant to the university's expertise; and access to university facilities. Universities may also increase their efforts and specialization around the mutually-agreed-upon field of collaboration, yielding even larger benefits to

industry than those initially contracted for. Thus, universities and corporations depend upon one another for success and sometimes, even survival. For more general discussions on university-industry research relationships, see Barber, 1985; Blumental, Gluck, Louis, Stoto and Wise, 1986; Business-Higher Education Forum, 1984; Cross, 1981; Prager and Omenn, 1980; Rosenzweig, 1982; Smith and Karlesky, 1978; Strickland and Vallance, 1967.

Although attention has been paid to industrial corporations as a source for complementary support to university researchers, the industry's share in supporting research conducted in universities is relatively small. "No increase above the rate of inflation is estimated in 1980 or 1981 for industry support for academic research...in spite of the increased attention now being devoted to discussions of university-industry cooperation among industry, university, and government leaders" (Shapley, Teich, Breslow and Kidd, 1980, pp. 79-80). On the average, the industrial support to the universities in the United States stands at about 7% of the universities' total research support. In examining the factors that affect the preference of university researchers, I examine the researchers' attitudes toward different types of external sources, without focusing on one specific source.

The Dependency of University Researchers on External Sources

University researchers' dependency on external sources and the researchers' considerations of monetary and non-monetary factors are the central concepts of this study. Researchers, like organizations, need resources for their professional survival. University researchers, whose professional "survival" and success are measured by the number of scientific articles they publish in professional journals, are dependent on both monetary and non-monetary resources. Those resources are available at the

researchers' focal institutions and in other, outside organizations. In public universities, researchers receive large proportions of their resources from state and local governments, while in private academic institutions, most of the resources are secured by the researchers themselves.[3]

Resource dependence theory, a perspective of organizational sociology, is a useful framework for explaining situations where organizations face high dependency conditions. These conditions happen when organizations have few alternatives to choose from, when acquiring resources. That is, when an organization is dependent on one or two external sources only, its dependency on each of the sources will be high. In this case, resource dependence theory can be used to explain the characteristics of these relationships. However, when an organization faces multiple choices of funding sources, then its relative dependence on each of these sources will be low (Shenhav, 1986). In this case, resource dependence theory can provide limited help in explaining the kind of relationships prevailing between the focal organization and external organizations.

Another sociological theory relevant to this context is exchange theory which deals with inter-organizational relationships within organizations, and which provided the seeds for the development of resource dependence theory. The term "exchange relations" is frequently used in the sociological literature as a synonym for the term "power relations," meaning that any exchange relation, by definition, is a form of power exchange.[4] Thus, if for example, university researchers transfer scarce information to industrial scientists, then these researchers maintain some power over the corporation with which these scientists are affiliated. This power is translated into exchange terms that can be expressed in different ways, e.g., monetary support, and exposure to "state of the art" technology.

Conversely, if an industrial firm provides a university researcher with new equipment needed for his or her work, the firm achieves some power over the researcher's work. In compliance with this power, the researcher might provide the firm with the results of a specific research before they are published. To what extent does this description reflect the collaborative process between researchers and their funding organizations? Do all exchange relations involve power relations, or are there other types of exchange relations that do not necessarily involve dependency relations?

To examine the implications of researchers' dependency on external organizations, on their preferences, I study the **considerations** that affect these preferences. In doing so, I assume that researchers are free to apply for any external source they choose.

Setting Up the Preferences

Assuming that researchers have preferences with regard to their funding sources, I postulate that university researchers will take into consideration a number of factors that might affect their decision. One approach to study the factors affecting the preferences of individuals derives from the studies of choice in the behavioral sciences. Taking into account Herbert Simon's concept of "bounded rationality" (1957) and the assumptions stated by Karl Weick (1976) and James March (1978) about the ambiguity of future preferences, I will examine the factors that affect the researchers' preferences. Is the decision affected by rational considerations motivated by reasons of self-interest, or do researchers act within a framework of bounded rationality that takes into account factors such as the interest of the community or the society, values, and other deontological positions? As stated by Etzioni, "[e]ven if you would accept the gross simplification that preferences are set rather than constantly

changing, morality enters into choices because of the important observation that choices are not simple, one-dimensional, one-time (or one 'stage') events but are in fact multi-faceted" (1981:31, author's emphasis.)

Looking at the preferences of human beings, neoclassical scholars argue that people would make their choice based on unequivocal motives. Thus, a person would tend to cooperate with the individual who "costs" the least. According to this approach, the feelings toward the "other", and the behavioral consequences that might result from collaboration with the "other" are not accounted for. A different approach suggests that exchanges are "multi-faceted, [and] that this quality is in part caused by moral factors, and that it requires major modifications in the prevailing paradigm of behavior, especially of exchange behavior" (Etzioni, 1989:70-71.) In the present study, I attempt to examine whether university researchers in the biosciences are better described as belonging to the latter category of people, who are ambivalent about their preferences, or to the group of people who unequivocally account for costs and benefits, on a purely utilitarian basis.

Using the above conceptual framework, I formulated the following hypotheses:

H_1: Levels of dependency on external sources will be related to monetary considerations affecting one's decision to collaborate with specific organizations. When facing high dependency on external organizations, researchers will tend to indicate monetary considerations as important factors in affecting their preference for a specific funding source.

H_2: Levels of dependency on external sources will be related to non-monetary considerations affecting one's decision to

collaborate with specific organizations. When facing low dependency on external organizations, researchers will tend to indicate non-monetary considerations as important factors in affecting their preference for a specific funding source.

One of the characteristics of public universities is that they receive higher percentage of funding from state and local government agencies than do private universities. Therefore, public universities are assumed to be less dependent on supplementary funds than their colleagues in private universities. Thus:

H_3: Researchers in public universities will tend to indicate more frequently non-monetary considerations as affecting their preference than do researchers in private universities.

Operationalization of the Theoretical Concepts

Measures of Dependency

In this study, the researchers' degree of dependency is indicated by the following three measures:

a. Number of supporting organizations. It is assumed that the higher the number of supporting organizations, the less the dependency of an individual on external sources.
b. Percentage of funding from a single funding organization out of the total support for research (e.g., percentage of support from NIH out of the total research funds, or the percentage of support from IBM out of the total research funds.) It is assumed that the greater the percentage of support from single external organization, the higher the dependency on that source.
c. Frequency of need to solicit for additional or supplementary research funding during the past five years. The relationship between this measure and level of dependency on external

organizations is discussed below.

The first two items were used in previous research to measure level of dependency (Shenhav, 1986; 1988). However, this is a first attempt to use frequency of solicitation as an indicator of level of dependency. This measure of dependency provides a **subjective criterion of dependency** which seems to act in two different (and contradictory) manners. I assume that low frequency of solicitation for additional support implies that the researchers have enough funding to support their ongoing scientific research. Otherwise, they would apply for supplementary funding more often.

The dual and contradictory effects of this measure of dependency take place when we attempt to understand the reasons behind people's decision to solicit frequently for additional support. The basic assumption related to high frequency of solicitation is that only people who do not have enough resources to maintain their current or expected level of scientific research will solicit more frequently for additional funding.[5] Among the researchers who solicit frequently for supplementary support, there are people who are depending on a few external sources, and there are those who get their support from multiple sources. Figure 1 illustrates the notion of frequency of solicitation for supplementary funding.

<Figure 1 about here>

High frequency of solicitation for additional research support can be motivated by both low and high levels of dependency on external sources. Therefore, it would be interesting to examine the effects of this variable, high frequency of solicitation, on the factors affecting one's decision to prefer one sponsoring organization over the other.
I identify two types of researchers according to level of

dependency on external organizations: 1) researchers who have a number of alternative funding sources available, and who, therefore, maintain low dependency on each of these external sources; 2) researchers who are dependent on one or two main external source of funding, and therefore, will be in a position of high dependency.

Measures of Considerations Affecting Preference

A number of considerations have been identified as affecting one's preference of one type of sponsoring organization or the other. These factors were grouped into two indices according to two criteria: monetary and non-monetary considerations. The index of monetary considerations includes the following three items: the amount of support offered by the sponsor, rapidity with which funds are available, and flexibility of use of these funds. The index of non-monetary considerations also includes three items: research orientation of the sponsor, non-monetary rewards offered by the sponsor (e.g., information exchange with colleagues, and exposure to 'state of the art' technology), and attitude of peers in the sub-unit (i.e., in the department, lab, or research center) and in the discipline towards the sponsor.

Based on interviews with researchers at the pre-test stage, an additional consideration was examined. Past experience with external sources was found to be an important consideration for researchers' preference. This item can apply to both monetary and non-monetary considerations.

A summary of the variables, indicators and their operationalization is described in Table 1.

<Table 1 about here>

Operationalization of the Hypotheses

Operationalizing the above hypotheses, I make the following predictions.

From the first hypothesis:
$P_{1.1}$: The number of supporting organizations is negatively related to the index of monetary considerations.

$P_{1.2}$: The percentage of support from a single organization is positively related to the index of monetary considerations.

$P_{1.3}$: The frequency of solicitation is positively related to the indext of monetary considerations.

From the second hypothesis:
$P_{2.1}$: The number of supporting organizations is positively related to the index of non-monetary considerations.

$P_{2.2}$: The percentage of support from a single organization is negatively related to the index of non-monetary considerations.

$P_{2.3}$: The frequency of solicitation is negatively related to the index of non-monetary considerations.

From the third hypothesis:
P_3: Given the different levels of support from state and local government agencies, it is predicted that researchers from public universities will tend to indicate more frequently considerations of non-monetary type than their colleagues at private universities.

Sample and Methods

This study is part of a larger study whose sample consists of

1,862 university professors from five private and public universities located in geographical proximity to industrial regions.[6] Out of the 1,862 researchers, 186 had to be dropped from the sample because of different reasons such as sabbatical, and moving to another university, to being inactive in conducting scientific research during the past couple of years. Forty three percent of the researchers completed a questionnaire from a sample of 1,676 eligible professors. The analyses of the whole sample are still in progress, and not all the available data have been entered into the computer. Thus, I tested the hypotheses of this study using only a sub-sample of respondents, including 325 professors affiliated with three universities, two of which are private institutions. All researchers were associated with the field of bioscience (i.e., departments of medicine, biology, and chemistry.) The data were collected through mailed questionnaires, that included close-ended questions.

Most of the researchers in the sample (90%) were dependent on support from the federal government. Funding from the various sources was not exclusive. Researchers might have received any combination of support (e.g., from the federal government and private foundations, or from a private foundation and commercial organizations, or from one source only.) Only twenty six out of 281 researchers who responded to the question about funding from state or local government agencies received support from these agencies. From these 26 researchers, 23 were affiliated with the public institution. Forty three percent of the researchers received support from private non-profit foundations, and about the same percentage of researchers (41%) received funding from commercial organizations.

<Table 2 about here>

Among the 313 researchers receiving federal government support, 252 got more than half of their total research support from these

agencies. Among these, 213 researchers (85%) received more than 50% support out of their total research funding from a single federal government agency. Thus, the majority of researchers in this sample (85%) were funded to a great extent by a single federal government agency. Very few researchers received more than 50% support out of their total research funding from a single organization that was state or local government agency, a private non-profit foundation, or a commercial organization.[7]

A small portion of the support was funded through the academic institutions. Most researchers reported that the support they have been receiving from their own institution approaches zero. Eighty eight percent of the respondents reported that the level of support coming from their institution (through academic department, lab, research center, or school) is "less then 25%" of their total research support. Again, most of the researchers receiving support from their institution were affiliated with the public university.

Results and Discussion

Three indicators of dependency were presented earlier to measure dependency of researchers on external sources. Two of these indicators, number of supporting organizations and the frequency of need to solicit for additional research support, were found to be correlated (value of 0.312 in Spearman rank order correlation, $N=316$; $p<0.1$ with two-tailed test). The third indicator, the percentage of support received from a single funding organization out of the total research support, was excluded from the analysis. Analyses showed that most researchers were heavily supported by the federal government agencies; hence, the variable had almost no variation across researchers.

For each hypothesis, I will present the results of the data analysis followed by a discussion of the findings.

The First Hypothesis

The first hypothesis examines the relationship between levels of dependency on external sources and monetary factors which affect one's decision to prefer certain funding organizations. More specifically, I hypothesized that high dependency on external organizations will be related to monetary considerations. It is assumed that at a high level of dependency, the question of survival becomes more critical, and therefore, monetary considerations would play an important role in the process of decision-making. The hypothesis was tested using a chi-square test which produces a contingency table to test whether the relationship between the raw and column variables is significant.

No significant relationship was found between the total number of agencies and monetary factors. Even when agencies that did not use peer-review criteria for evaluating research proposals were excluded, no statistical significance was found.[8] A statistically significant relationship was found between the frequency of solicitation for additional or supplementary research funding and monetary factors.

<Table 3 about here>

A general implication of the above table is that among the different levels of frequency of solicitation, most researchers (N=104 or 35%) solicit for additional research funding less frequently than once every two years (value "1".) This is a relatively low frequency which implies that the researchers in this sample do not feel highly dependent on external support, otherwise they would solicit for supplementary support more often. Sixty three percent of the 300 respondents solicit for external funding about once every two years or less.

The findings of the chi-square test imply that there is a

significant relationship between the different levels of frequency of solicitation and the factors affecting one's decision of preference. A look at the high ("4") vs. the low ("1") levels of frequency of solicitation reveals that there are differences between the two extremes of the scale regarding the monetary factors. These differences were tested using a chi-square test, and found statistically significant as follows: The first comparison tested the differences between the highest level of solicitation ("4") and the lowest level ("1") of solicitation. The second comparison tested the difference between the two highest frequencies of solicitation ("3"+"4"; N=110) and the lowest frequency ("1"; N=104). Both tests showed statistically significant differences, at values of 6.19 and 7.40 respectively, with df=2 and $p<0.05$. This finding implies that a significant relationship exists between the extreme scores of frequency of solicitation and the consideration of monetary factors.

A look at the highest category of monetary factors ("2-3")--which refers to respondents who mentioned two or all three items that compose this variable--reveals large differences among the researchers at the different levels of frequency of solicitation. As shown in Table 3, among the researchers who solicit for additional research support less frequently than once every two years ("1") only 18% mentioned 2 or 3 items of monetary factors as affecting their decision of preference. Among those who solicit for supplementary funding about once every two years ("2"), 40% indicated 2 or 3 items of monetary considerations. The results for the last two categories of frequency of solicitation ("3", and "4") are 33% and 37% respectively. Thus, researchers who apply frequently for additional funding tend to emphasize the importance of monetary factors more strongly than do researchers who apply for support least frequently.

The past experience of researchers with external funding sources

was tested for significance in its relations with the different measures of dependency. Frequency of solicitation was the only measure of dependency that was statistically significantly related to past experience. Neither the total number of agencies nor the total number of "peer" agencies (agencies that maintain peer-review procedures) were significantly related to past experience.

<Table 4 about here>

Most researchers (67%) mentioned past experience with the sponsoring organizations as an important factor in affecting their preferences. This variable was not included among the monetary or non-monetary factors, but rather as an item that can embody both notions. Table 4 shows that most researchers considered their past experience with sponsoring organizations as affecting their preference.

To summarize, the first hypothesis of the study was partially supported. Monetary factors were found to be statistically significantly related to one measure of dependency, namely the frequency of solicitation for additional support. While the chi-square test for contingency tables does not identify the differences in responses between groups, an examination of the frequency table suggests that researchers who solicit frequently for research funds are more inclined to indicate more items as monetary considerations than are researchers who solicit for additional support less frequently.

The Second Hypothesis

The second hypothesis examines the relationship between levels of dependency on external sources and non-monetary factors. More specifically, I hypothesized that low dependency on external organizations will be related to non-monetary considerations. It is assumed that when researchers do not face critical issues such

as survival, they will tend to look for other considerations, beyond monetary ones.

The same three indicators of dependency were used to test the significance of relationships between the variables. The categories composing each of the three indicators had to be collapsed because of too many sparsed cells. Total number of agencies, frequency of solicitation, and total number of agencies maintaining peer-review procedures did not show significant relationships with non-monetary considerations.

However, a further analysis of the data suggested that distinguishing between tenured and non-tenured researchers might yield different results. It was assumed that tenured researchers would tend to feel more secure with regard to their level of funding, and therefore, will be more inclined to indicate non-monetary considerations. Thus, non-tenured researchers were excluded from the sample for the purpose of this hypothesis. A chi-sqaure test showed statistically significant relationship between the different levels of frequency of solicitation for additional support and non-monetary considerations.

<Table 5 about here>

Most of the researchers (65%) in the sample of 325 respondents were tenured. Among them, 64% solicited for additional research funding about once every two years or less, and 15% solicited for funding more frequently than once a year. It is interesting to learn what are the factors relevant to tenured professors that distinguish them from the non-tenured ones when issues of non-monetary considerations are raised?

Using the resource dependence perspective, one could argue that young investigators are expected to be more dependent on external sources than their senior colleagues who have already

established connections and relationships with potential sponsors to support their research. Therefore, untenured professors will be less concerned with non-monetary factors such as research orientation of the sponsor, exchange of information with colleagues, or exposure to the "state of the art" technology, and more concerned about acquiring monetary resources.

To summarize, the second hypothesis was partially supported. Non-monetary factors were found to be statistically significantly related to one measure of dependency, namely the frequency of socilicitation for additional support. This relationship was found only with a sub-sample of tenured researchers only.

The Third Hypothesis

In the last hypothesis, I predicted that researchers from the public universities who received state and local government funds were expected to refer differently than researchers in private universities to the factors affecting their preferences. It was assumed that people who receive a priori some kind of support, will tend to feel less dependent on resources from external sources. Therefore, they might take into account non-monetary considerations when making the decision about the preferred organization. Faculty from private institutions rarely receive state or local government support, and hence were expected to consider their monetary needs first. Only after some of the monetary needs have been fulfilled, were researchers expected to consider non-monetary factors as well.

To examine the differences between researchers from private and public institutions with regard to non-monetary considerations, a t-test for independent samples was used. For each item composing the index of non-monetary considerations, a t-test was conducted to examine the differences between researchers affiliated with the two types of institutions. Non-monetary rewards offered by

the sponsor (e.g., information exchange with colleagues, exposure to "state of the art" technology, etc.) was the only item which showed statistically significant difference between private and public universities. The other items composing the non-monetary index were not significantly different between private and public universities.

<Table 6 about here>

This finding supports the hypothesis which states that researchers associated with public institution will tend to indicate more often non-monetary considerations. However, the hypothesis was not fully supported because not all the items composing the non-monetary index showed significant differences between the two types of institutions.

Further analyses were conducted to test the significance of relationship between the measures of dependency and non-monetary considerations for the private and public universities independently. Chi-square tests could not be used to compare between the two private universities and the one public institution because of too many cases of sparse cells. Over 20% of the fitted cells had a frequency of less than 5 cases in each cell. As a result of this, categories of most variables were collapsed. Even after combining the adjacent cells, some of the variables had more than 20% of their fitted cells with less than 5 cases.

The only variable which was significantly related to non-monetary factors was the frequency of solicitation for additional support. However, this significant relationship was found only in the private universities. The single public university that was sampled did not show such a relationship. In both cases, the frequency of solicitation variable was collapsed to 3 items, combining the 3rd and 4th items to eliminate the occurance of

less than 5 cases in a cell.

<Table 7 about here>

This finding, which was contrary to the hypothesis, may be a result of the general findings presented earlier. The total number of respondents who received any kind of state or local government support was 26 (8% of the whole sample.) Indeed, 23 of them were associated with the public institution, but none of them received state or local government support that exceeded 50% or more of their total research funding. The level of support that the 23 researchers received from state/local government agencies ranged from 2% to 30% out of their total research funding. Thus, it is not surprising that no significant relationships were found between being associated with public institutions and the importance attached to non-monetary factors.

Summary and Implications

In this study, I attempted to examine the relationship between degree of dependency and monetary or non-monetary considerations. I hypothesized that indication of monetary and non-monetary factors would be related to levels of dependency on external sources, the latter measured by two indicators: total number of agencies, and frequency of solicitation for additional support.

Monetary and non-monetary considerations were found to be statistically significantly related to one measure of dependency, namely the frequency of solicitation for additional support. With regard to the non-monetary variable, this relationship was found significant after excluding the non-tenured professors from the sample. The variable of frequency of solicitation provides a new insight to the view of resource dependency relationships and should be studied further. This variable does not concur with the more "classical" measure of dependency, namely--total number of

external organizations the actor (or an organization) is dependent upon. As shown in Figure 1, one can solicit frequently for additional support and be either funded by few or by a multiple organizations. The common characteristic between a researcher funded by a few organizations and a researcher funded by multiple organizations is, that both researchers have low level of support. Both researchers frequently solicit for additional support because they need more funding to carry out their current or expected research.

The ambiguity perceived in the concept of frequency of solicitation for additional support suggests that more research is needed to explore the essence of this attribute: does high frequency of solicitation imply high or low level of dependency, or does it embrace both? Under what conditions would high frequency of solicitation imply high level of dependency on external sources, and under what conditions would it imply the opposite? Can we rely on subjective measures such as this one to indicate a certain level of dependency? All these questions need to be addressed in further research.

Monetary and non-monetary factors were not found to be statistically significantly related to other measures of dependency. Total number of external sources and total number of agencies which apply peer-review procedures to evaluate research proposals did not show significant relationship with monetary or non-monetary factors. This finding could be the result of the reality faced by most researchers in the past years, namely budget cuts. Budget cuts, regardless of the number of organizations researchers are dependent upon, might encourage individuals to consider virtually any monetary factor available. Hence, no variance could be revealed among researchers with relation to this attribution.

However, it might be that one or more of the items that compose

the monetary and non-monetary variables was significantly related to the measures of dependency. But, when the variables were combined to create the index of monetary vs. non-monetary considerations, the significant relationships disappeared. This might be a measurement problem which I plan to investigate at the next stage of the data analyses, when the whole data are entered into the computer.

The implications of the findings of this study are that researchers applying to different funding sources were not attracted by the wide range of advantages this relationship offers. The long list of positive effects that characterize the relationship between university and external funding sources did not appeal to the researchers in the sample. These faculty seem to face survival problems which they believe can be resolved mainly by increasing the financial support. This information has important implication for policy-makers at the academic institutions as well as at the funding organizations who attempt to mediate between professors and funding sources. The policy-makers need to be aware of the finding that both researchers who are highly dependent on external sources, and those who are not highly dependent on external funding, do not tend to consider non-monetary factors. Given the harsh realities facing researchers today, it seems that all they can consider is survival--that is monetary considerations, and unfortunately, non-monetary considerations, such as professional stimulation, rarely enter into the equation.

Notes

1.Characteristics of university-industry research relationships refer to statements such as: "provide intellectual stimulation to faculty", increase the awareness of "the state of the art as practiced in industry, and provides material that can enrich classroom teaching" (Brown, 1985:11); involve "less red tape than federal funding" (Blumenthal et al., 1986:1364); increase "the university community's sensitivity to industrial needs prompting university researchers to consider the industrial applicability of university research and development thereby increasing the generation of new, industrially relevant ideas" (Baruch Jordan J. testimony before the Subcommittee on Science, Research, and Technology, 1979, p. 378); provides an "access to additional or complementary technical and physical resources made available by industry"... enhances "public credibility for service to society" (National Commission on Research, 1980:15);

2.External funding sources include federal government agencies, state/local government agencies, private non-profit foundations, and commercial organizations.

3.For example, University of California, Berkeley received 54% of its funding from state and local government for the year ending on 6/30/87 compared to 3.8% of Stanford University's state and local government support at that time. See, Stanford University, 1987, and University of California, 1987.

4.See for example, Emerson (1962) and Blau (1964). In most cases, exchange theory and dependency theory are used interchangeably.

5.This measure of dependency is a subjective matter. An outside observer might argue, based on relevant information about the research activities of the researcher, that the researcher does have enough funding to carry on his or her ongoing research and need not be concerned about raising more funding in the near future. Hence, it is the researchers' perception and inclination that affect their decision to apply more frequently for additional support.

6.The importance of including universities that are surrounded by similar geographical areas derives from the assumption that industrial corporations and academic institutions tend to develop research partnership if they are geographically close to each other.

7.Only two researchers from the sample of 325 researchers received state or local government funds that exceeded 50% of their total research funding. Eleven percent of the 122 researchers receiving support from private non-profit foundations

got more than 50% of their support from these agencies. A similar percentage of researchers (14%, N=17) received more than 50% support from commercial organizations. Note that the above data refer to researchers who received more than 50% of their total research support from a specific source, rather than from a specific organization. A researcher receiving 90% of his or her total research support from three private non-profit foundations differs greatly from a researcher who receives 90% of the total support from a single private foundation. The researchers' level of dependency on external organizations in each of the cases is very different, and might affect their considerations of preference.

8.Shenhav (1988) has adopted the meaning of internal funding from resource dependence theory which states that internal actors are those who are governed by peer-review procedures. Thus, internal funding in this context refers to funds received from agencies that use academic criteria to evaluate research proposals.

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Figure 1. Relationships Between Number of External Supporting Agencies and Frequency of Solicitation for Additional Support

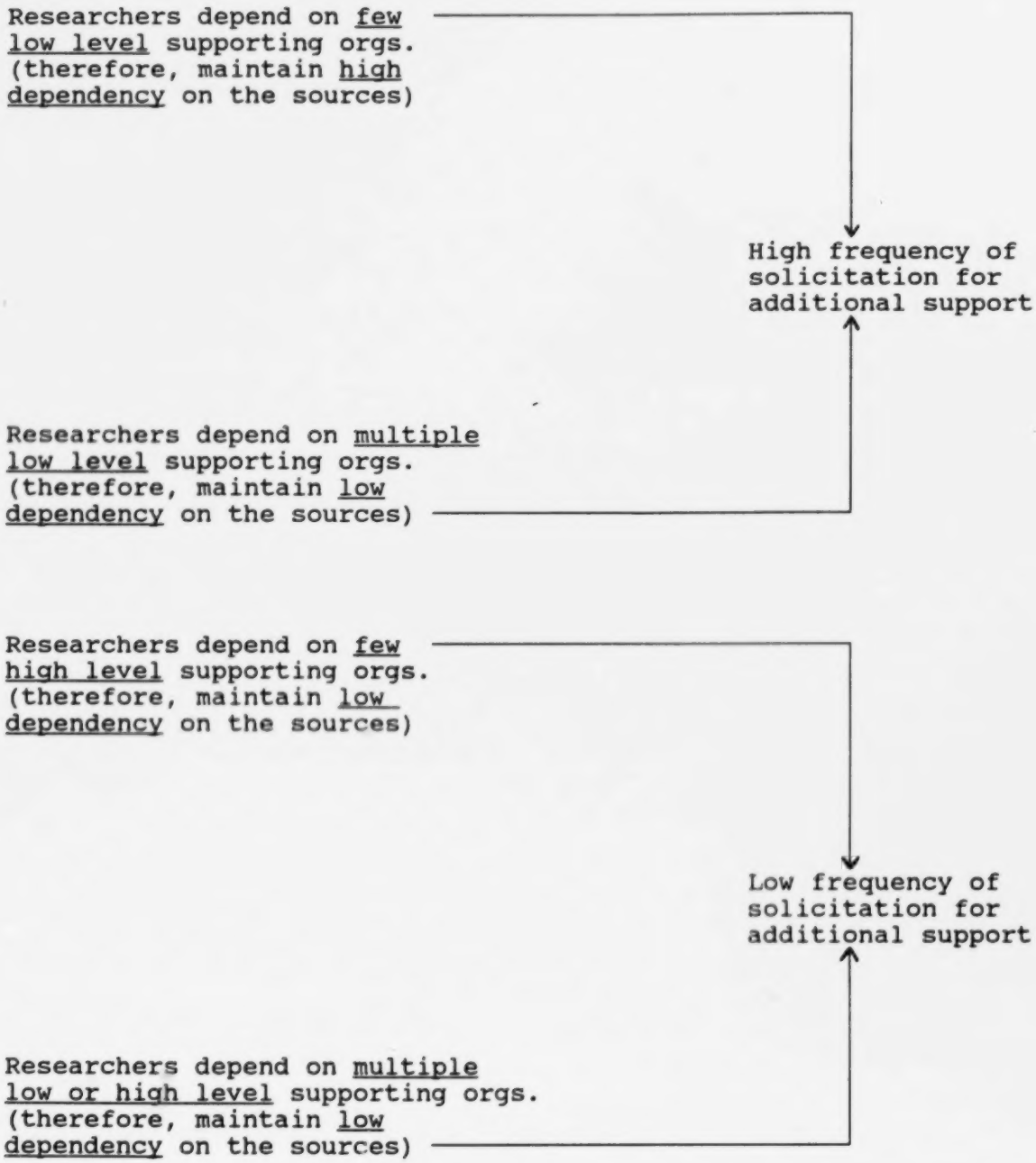
Researchers depend on few low level supporting orgs. (therefore, maintain high dependency on the sources)
High frequency of solicitation for additional support
Researchers depend on multiple low level supporting orgs. (therefore, maintain low dependency on the sources)
Researchers depend on few high level supporting orgs. (therefore, maintain low dependency on the sources)
Low frequency of solicitation for additional support
Researchers depend on multiple low or high level supporting orgs. (therefore, maintain low dependency on the sources)

Table 1. Summary of Variables, Indicators and Their Operationalization

Variable	Indicated by	Questionnaire item
Dependency on external sources	1.Number of supporting organizations 2.Frequency of solicitation for additional research support 3.Percentage of support from every single funding organization out of the total research support	1.For each type of funding source, the respondents completed the following statement: "Currently, I am funded by ____ agencies. Out of those agencies, ____ use peer-review procedures." 2."During the past five years how often has it been necessary to solicit for additional or supplementary research funding?" An ordinal scale of 4 options was provided. 3."Of the total support raised from external sources, roughly what percentage has come from each of the following organizations?" A list of all potential types of sponsors was provided. With regard to federal government agencies, an additional question was asked: "For each grant you currently have from federal government agencies, please indicate the supporting agency and the percentage of the total government support represented by that category."
Monetary considerations	1.Amount of support offered by the sponsor 2.Rapidity with which funds are available 3.Flexibility of use of the funds	"From the list below, please rank the three factors which most affect your choice of sponsoring organizations to which to submit proposals for funding." A list of 7 items was provided with the 8th item being the "other" category. Since about 40% of the respondents did not rank the factors, I refer to the three items as marked factors, rather than as ranked items. The items that composed the monetary considerations index were: the amount of support offered by the sponsor; rapidity with which funds are available; and flexibility of use of the funds.
Non-monetary considerations	1.Research orientation of the sponsor 2.Non-monetary rewards offered by the sponsor (e.g., information exchange with colleagues, exposure to "state of the art" technology, etc.) 3.Attitude of peers in the sub-unit (i.e., in the department or lab) and in the discipline towards the sponsor	The same question as the above. Again, the items were combined to create one variable to be called non-monetary factors. The items that composed the non-monetary considerations index were: research orientation of the sponsor; non-monetary rewards (e.g., information exchange with colleagues, exposure to "state of the art" technology); and attitude of peers in the sub-unit (i.e., in the department or lab) and in the discipline towards the sponsor

Table 2. Frequency Distribution of Researchers Receiving Support From External Sources

Type of External Agency	No Funds From This Source	Number of Funding Organizations					
		1	2	3	4	5+	Total
Federal Government	31 (10%)	157 (50%)	101 (32%)	21 (7%)	2 (1%)	1 (0%)	313 (100%)
State/Local Government	255 (91%)	23 (8%)	3 (1%)	0	0	0	281 (100%)
Private Foundations*	163 (57%)	98 (34%)	17 (6%)	5 (2%)	2 (1%)	0	285 (100%)
Commercial Organizations	171 (59%)	77 (27%)	27 (9%)	6 (2%)	6 (2%)	4** (1%)	291 (100%)

* Private foundations refer to non-profit organizations only
** This category includes 5 or more commercial organizations

Notes:

Each category of the raw variable is not exclusive. That is, researchers can be funded by a number of external sources simultaneously.

The total number of respondents differ in each category of the raw variable because of missing values.

Table 3. Crosstabs of Frequency of Solicitation for Research Funds and Monetary Factors Affecting Preference

Monetary Factors[1]	Frequency of Solicitation for Research Funds				
	Less freq. than once every two years "1"	About once every two years "2"	About once a year "3"	More freq. than once a year "4"	Total
0 item	9	8	5	2	24
1 item	76	44	38	27	185
2-3 items	19	34	21	17	91
Total	104	86	64	46	300

Likelihood ratio chi-square value 13.74 with df=6; $p<.05$

[1] The index of monetary factors is the sum of three variables: 1)amount of support offered; 2)rapidity with which funds are available; 3)stability of the support. If no indication of these items was made, the value "0" was assigned. Value "1" refers to one item mentioned by the respondent regarding the monetary variable. Value "2-3" refers to two or all three items mentioned by the respondent. Since there were very few cases in which researchers marked all three items as monetary ones, the "2-3" category was combined.

Table 4. Crosstabs of Frequency of Solicitation for Research Funds and Past Experience of Researchers with Sponsoring Organizations

Past Experience	Frequency of Solicitation for Research Funds				
	Less freq. than once every two years "1"	About once every two years "2"	About once a year "3"	More freq. than once a year "4"	Total
No past experience	28	40	19	17	104
Past exper. affected preferene	83	51	47	31	212
Total	111	91	66	48	316

Likelihood ratio chi-square value 8.57 with df=3; $p<.05$

Table 5. Crosstabs of Frequency of Solicitation for Research Funds and Non-monetary Factors Affecting Preference
A Sample of Tenured Professors Only

Non-Monetary Factors[1]	Frequency of Solicitation for Research Funds				
	Less freq. than once every two years "1"	About once every two years "2"	About once a year "3"	More freq. than once a year "4"	Total
0 item	16	11	11	12	50
1 item	47	35	31	14	127
2-3 items	11	15	2	5	33
Total	74	61	44	31	210

Likelihood ratio chi-square value 13.27 with df=6; $p<.05$

[1] The index of non-monetary factors is the sum of three variables: 1)research orientation of the sponsor; 2)non-monetary rewards offered by the sponsor (e.g., information exchange with colleagues, exposure to "state of the art" technology, etc.); 3)attitude of peers in the sub-unit (i.e., in the department or lab) and in the discipline towards the sponsor. If no indication of these items was made, the value "0" was assigned. Value "1" refers to one item mentioned by the respondent regarding the non-monetary variable. Value "2-3" refers to two or all three items mentioned by the respondent. Since there were very few cases in which researchers marked all three items as non-monetary ones, the "2-3" category was combined.

Table 6. T-test Results for Independent Samples, Differences between Universities Regarding Non-monetary Rewards

Type of University	N	Mean	SD	T-value
Private	134	0.030	0.171	
Non-private	191	0.084	0.278	2.162*

* Significant at 0.05 level (d.f.=318)

Table 7. Crosstabs of Frequency of Solicitation for Research Funds and Non-monetary Factors Affecting Preference A Sample of Private Universities Only

Non-Monetary Factors[1]	Frequency of Solicitation for Research Funds			
	Less freq. than once every two years "1"	About once every two years "2"	Once a year or more often "3-4"	Total
0 item	9	9	16	34
1 item	28	14	24	66
2-3 items	5	10	2	17
Total	42	33	42	117

Likelihood ratio chi-square value 12.28 with df=4; $p<.05$

[1] The index of non-monetary factors is the sum of three variables: 1)research orientation of the sponsor; 2)non-monetary rewards offered by the sponsor (e.g., information exchange with colleagues, exposure to "state of the art" technology, etc.); 3)attitude of peers in the sub-unit (i.e., in the department or lab) and in the discipline towards the sponsor. If no indication of these items was made, the value "0" was assigned. Value "1" refers to one item mentioned by the respondent regarding the non-monetary variable. Value "2-3" refers to two or all three items mentioned by the respondent. Since there were very few cases in which researchers marked all three items as non-monetary ones, the "2-3" category was combined.